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Scientific images, precious mud and bizarre life forms from the bottom of the sea

Last week, the focus was on benthic animals living in, on, and at the seabed. Around Antarctica, the benthos is, in general, significantly richer in species than the plankton. It also produces large quantities of biomass, which can reach world record values.

Often, however, the benthos does not receive the attention it deserves due to the fact that none of the benthic species plays such a prominent role in the ecosystem as krill. Furthermore, the benthos communities often lack charismatic species like seals, penguins and whales. Never the less, the benthos is of central importance for the recycling of organic material (mainly micro algae from the water column) that accumulates at the seabed. Many of the benthic organisms are fixo-sessile. This means that they are permanently attached to a particular spot on the seabed. Thus, these organisms cannot change their location. If the environmental conditions changes and living conditions decrease, they have to bear it or die. Therefore, these organisms have developed manifold adaptation mechanism, which makes them very good environmental indicator species. For this reason benthic organisms have been the focus of international collaborative research at the AWI for many years.


Fig. 1: After a muddy catch, both working deck and workers need a good rinse. © Chantal de Ridder, ULB, Belgium

‘Only 10 more meters to the seabed’ Dieter instructs the winch operator. The Ocean Floor Observation System (OFOS), borrowed from the AWI Deep-Sea Group, is slowly approaching the seabed sending the first images up to the ship. Is the camera working? What does the benthic community look like? Will our hypotheses be supported or not? Approaching the seabed with the OFOS is always a very exciting moment!
On arrival in a key area, a bathymetric survey is performed the night before the actual station work. This provides a high resolution quasi-3D image of the seafloor for accurate site selection and station planning. For the larger study areas (key sites), we collect as many representative and comprehensive data sets of the seabed as possible for an integrated, ecosystems approach. It is, however, important that the bottom penetrating equipment (multi-corer, box corer) is not used on hard ground and rocky outcrops. Therefore, the bathymetry is a valuable tool to find the right spot. For example, soft sediments often accumulate in seabed depressions while elevations and cliff edges are often swept clear by currents of any fine sediment thus providing hard substrate for organisms to settle. From high-resolution seabed maps, this information can be extracted and used for detailed sampling site planning and later for the interpretation of the biological results.
The next level of detail is then provided by the visual seabed images recorded with OFOS. In addition to the valuable biological data, the OFOS images also show the sedimentary characteristics of the seabed in the area. This is one of the reasons why Freija and Gritta eagerly stare at the OFOS screens. They use the seabed information to find nice soft sediments for their multi-corer deployments and to avoid areas of rocky seabed. This information is also important to Enrique and Heike, who study benthic processes. After the OFOS, usually the multi-corer is deployed. The multi-corer is a device that penetrates the seabed for 20 to 40 cm with a set of 6 or 10cm diameter plastic tubes. As it is pulled out of the sediment, spring-loaded lids close the bottoms and the tops of the tubes. If everything works well a piece of the sediment with the overlying bottom water is punched out of the seafloor and transferred undisturbed on the deck. These multi-corer samples are called sediment cores. On board, the sediment cores are sliced into thin sections that will later be analyzed for small animals (meiobenthos) and environmental parameters.
Another approach is to study specific biological processes in the sediment cores directly under controlled temperature

conditions. This helps us understand recycling processes at the seabed mentioned previously. Heike and Dieter elaborate an experimental set-up to study these processes. During the first day, with the support of Enrique, they collected numerous sediment cores. To study the influence of increased (higher than current levels in the natural environment) nutrients and concentrations of organisms on recycling rates, extra algae and organisms were added to some cores. The sediment was then sieved after a week of repeated oxygen and nutrient consumption measurements to extract the animals. This work was done with the help of Freija and Gritta. Back on shore, these samples will be analyzed in the lab to study which animal at which nutrient level recycled how much organic material.

After the multi-corer the Agassiz-Trawl (AGT) is usually deployed. The AGT is a dredge, a type of 3m-wide sledge that is trawled over the seabed. Depending on the seabed, it can contain large volumes of sediment with only a little bit of biomass or occasionally, large quantities of benthic animals. Then all the interested scientists systematically work up the AGT hauls. In this way, still on board, the mixed pile of sediment and animals on the back deck is quickly converted into informative, valuable data sets. The battles for desirable specimens at the Agassiz hauls are significantly more disciplined these days than they used to be. During the Agassiz trawls sampling on deck, Astrid is in charge of the protocol and responsible for a smooth and effective workflow. Once everything is catalogued, the experts select individual samples and specimen for their specific research. Bruno and Chantal's expertise are sea urchins, while Dorte and Daniel focus on sponges, Cedric and Marie target amphipods, Pablo, Nuria and Irene hunt coral relatives and Marc searches for brittle stars. Andrea and Maria Chiara's research is not focused on specific organism or organism groups. Their research addresses the relationships between organism such as parasitism and symbioses.
The often bizarre animals, which mostly do not even look like animals, are also welcome catches for the ZDF TV-team on board. Very attractive are, of course, the bright green and orange sponges, amphipods with delicate patterns on their back and giant starfish with not only the usual five arms but up to 40. Despite the tight working program, there is always time to admire nature's beautiful shapes and colors. Sometimes, it is intriguing, how tiny little creatures can excite the experts when, for example, Pablo discovers a new inconspicuous species of soft corals. On the other hand there are also disappointments when hauls turn out to be less exciting than anticipated.
The benthos work is complimented by CTD casts and krill hauls. The more information we can integrate into our models of the ecosystems, the more promising is our approach to correlate benthic ecosystem distributions and benthic processes with environmental parameters. This is the basis for estimates on the impact of continued regional warming at the Antarctic Peninsula.

Fig. 2: A typical Agassiz trawl haul from rocky seabed. © Cedric d'Udekem d'Acoz

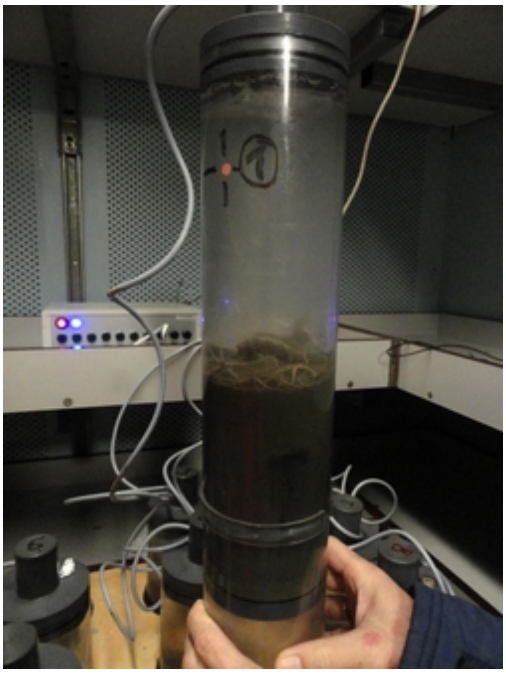

Fig. 3: A sediment core in preparation for biological recycling experiments. © Heike Link, McGill, Canada

The last week ended with a short oceanography and krill transect across the Bransfield Strait. During the transect, the winds picked up and we have been once again reminded that we are on a ship.

On behalf of everybody on board, I send our best greetings home from windy and rarely sunny Antarctica.

Julian Gutt